Journal of Surgical Oncology 64:32–35 (1997)

Comparison of the Surgical Results of Lobectomy With Bronchoplasty and Pneumonectomy for Lung Cancer

ICHIRO YOSHINO, MD,* HIDEKI YOKOYAMA, MD, TOKUJIRO YANO, MD, TAKASHI UEDA, MD, EIJI TAKAI, MD, KAZUKI MIZUTANI, MD, HIROSHI ASOH, MD, AND YUKITO ICHINOSE MD
Department of Chest Surgery, National Kyushu Cancer Center, Fukuoka, Japan

Background: We retrospectively compared sleeve lobectomy (SL) and pneumonectomy (PN) for lung cancer in terms of surgical complications and postoperative disease-free survival, as well as incidence and pattern of recurrent disease.

Methods: From 1977 to 1993, 29 patients with primary lung cancer underwent sleeve resection at our institution. The pneumonectomy group consisted of 29 cases that had been selected during the same period according to the following criteria: (1) in a tumor located in the upper lobe, there was no invasion within 1 cm from both the carina and the orifice of the middle and the lower lobe bronchus, whereas in a tumor located in the middle or lower lobe, there was no invasion within 1 cm of the orifice of the upper bronchus, (2) there was no invasion to the trunks of the pulmonary vessels, (3) there was no invasion to any other lobes, (4) a complete resection was achieved.

Results: No differences were observed between the two groups regarding stage, histological population, or age. The incidence of postoperative complications was 13.7% in the SL group (2 cases each of pneumonia and arrythmia), and 24.1% in the PN group (3 bronchopulmonary fistula, 2 bleeding, 1 instance each of arrythmia and acute cardiac failure, and 2 operation-related deaths) ($P < 0.05$). The 3-year disease-free survival was 65.7% in SL, 58.8% in PN (no statistical significance in the log-rank test). Recurrent disease was observed in the local regions of three patients in the SL group and six patients in the PN group, and at distant organs of six patients in the SL group and seven in the PN group.

Conclusions: These findings thus suggest that as a curative treatment, lobectomy with bronchoplasty may be a safer procedure than pneumonectomy for lung cancer. J. Surg. Oncol. 64:32–35

KEY WORDS: lung cancer; bronchoplasty; pneumonectomy

INTRODUCTION

A pulmonary lobectomy with bronchoplastic procedures is a lung-parenchyma-sparing operation for centrally located lung tumors, whereas a pneumonectomy (PN) is an alternative treatment modality for such tumors. The first sleeve lobectomy (SL) of the lung was performed by Price-Thomas in 1942 [1], and in the 1960s, this operation was first applied to malignant lung disease [2,3]. Since then, SL has been recognized as an alternative operation for patients who were believed to be incapable of tolerating a PN because of an inadequate pulmonary reserve. Until recently, many reports have

*Correspondence to: Department of Chest Surgery, National Kyushu Cancer Center, 3-1-1 Notame, Minami-ku, Fukuoka 815, Japan.
Accepted 30 August 1996

suggested that sleeve resection can achieve adequate curability with low morbidity and mortality for lung cancer [4–7], and it is now accepted as one of the standard treatments of a cancer.

Although a PN is often the first choice for such central lung tumors that involve the hilum, trunks of pulmonary vessels, or other lobes, tumor-uninvolved lobes can be saved by the use of bronchoplastic procedures in certain cases. We therefore selected PN cases that also could have had a sleeve lobectomy and then retrospectively compared the findings of a sleeve lobectomy with those cases regarding surgical complications, postoperative disease-free survival, and the incidence and forms of recurrence.

MATERIALS AND METHODS

In the period from 1977 to 1993, a total of 32 patients with primary lung cancer underwent a sleeve lobectomy at the Department of Chest Surgery, National Kyushu Cancer Center. Of them, 29 patients had a complete resection (SL group). The mean age of the SL group was 60.6 ± 8.7 years, ranging from 36 to 75, and was comprised of 26 males and 3 females. There were 19 squamous cell carcinomas, 4 adenocarcinomas, 2 small cell carcinomas, 2 adenoid cystic carcinomas, and 1 case each of large cell carcinoma and undifferentiated carcinoma. In addition, 9 cases were stage I, 12 were stage II, and 8 were stage IIIa [8] (Table I). The indications for bronchoplasty were central tumors in 22 patients and hilar node disease in 7. A sleeve lobectomy was done in the right upper lobe in 16 patients, the right middle lobe in one, the right middle and lower lobes in one, the left upper lobe in 8, and the left lower lobe in 3. Normally, an immediate microscopic inspection of the resection margins by means of a frozen section was done to confirm a complete resection. Seven cases underwent combined angioplastic surgery on the trunk of the pulmonary artery.

During the same period, a total of 129 patients with primary lung cancer underwent a pneumonectomy. We then selected 29 of these cases in order to compare their findings with the SL group according to the following criteria: (1) in a tumor located in the upper lobe, there was no invasion within 1 cm from both the carina and the orifice of the middle and the lower lobe bronchus, whereas in a tumor located in the middle or lower lobe, there was no invasion within 1 cm of the orifice of the upper bronchus, (2) there was no invasion to the trunks of the pulmonary vessels, (3) there was no invasion to any other lobes, (4) a complete resection was achieved. This determination was done based on the clinical records. The mean age was 58.2 ± 9.5 years and ranged from 35 to 72. This pneumonectomy group (PN) comprised 20 squamous cell carcinomas, 5 adenocarcinomas, and one each of large cell carcinoma, small cell carcinoma, adenosquamous cell carcinoma, and undifferentiated carcinoma. In addition, there were 9 cases classified as stage I, 12 as stage II, and 8 as stage IIIa (Table I).

A follow-up examination was, in general, done every 2 months for the first 2 years and thereafter every 3–4 months. The examination included a physical, a complete blood count, blood chemistry, and chest radiography. Although a few patients routinely underwent screening examinations by computed tomography (CT), a radionuclide bone scan, and bronchoscopy once or twice per year after the operation, the majority of patients underwent CT, radionuclide bone scan, or bronchoscopy only when symptoms related to recurrence appeared. The recurrent disease was then confirmed by a biopsy if clinically feasible. In cases in which it was not feasible, radiographic evidence (roentgenography, CT, or radionuclide scan) was accepted.

The two groups were then compared regarding operative complications and postoperative disease-free survival. The disease-free survival rates were calculated from the operation day using the method of Kaplan and Meier, and a statistical comparison was performed using the two-tailed log-rank test. Any differences between the proportions were evaluated using either the Chi-square test or Student's t-test. The statistical difference was thus considered significant when the *P*-value did not exceed 0.05.

RESULTS

Profile of Patients

No statistical differences were observed between the SL group and the PN group regarding sex, age, histological types, pathological stages, T factor or N factor (Table I). Both groups were also considered to have a similar extent of disease.

Operative Risk

No intraoperative death was observed in either group. The postoperative complication rate was 13.7% in the SL group (2 cases each of arrhythmia and pneumonia), and 24.1% in the PN group (3 cases of stump failure, 2 of hemorrhage, 1 of arrhythmia, and 1 cardiac failure) ($P < 0.05$) (Table II). The operation-related mortality was 0 % in the SL group and 6.9% in the PN group ($P < 0.05$). Hemorrhage and cardiac failure were the causes of death in the two cases who died (Table II).

Long-term Results After Operation

The disease-free survival was 65.7% in SL, 58.8% in PN at 3 years after operation, and there was no statistical significance in a log-rank test (Fig. 1). Local recurrence was observed in three patients from the SL group, and in six from the PN group, and distant metastases were detected in six patients of SL group and seven of PN group

TABLE I. Patient Profile of SL and PN Groups

		Sleeve lobectomy	Pneumonectomy	Significance
N		29	29	
Male/female		26/3	23/6	ns[a]
Age[b]		60.6 ± 8.7 (36–75)	58.2 ± 9.5 (35–72)	ns
p-stage	I	9	9	
	II	12	12	ns
	IIIa	8	8	
p-T	1	7	5	
	2	16	20	ns
	3	6	4	
p-N	0	11	10	
	1	15	13	ns
	2	3	6	
Histological types[c]				
	Sq	19	20	
	Ad	4	5	
	La	1	1	
	Sm	2	1	ns
	Adsq	1	1	
	Adcys	2	0	
	Undiff	0	1	

[a]No statistical significance found between SL and PN.
[b]Mean ± standard deviation.
[c]Sq: squamous cell carcinoma, Ad: adenocarcinoma, La: large cell carcinoma, Sm: small cell carcinoma, Adsq: adenosquamous cell carcinoma, Adcys: adenoid cystic carcinoma, Undiff: undifferentiated.

TABLE II. Operative complications

	Postoperative complications
SL (N = 29)	4 (13.7%) 2 pneumonia, 2 arrhythmia
PN (N = 29)	7 (24.1%)[a] 3 bronchopleural fistula 2 hemorrhage, 1 arrhythmia 1 cardiac failure

[a]Statistical significance was seen in comparison with SL.

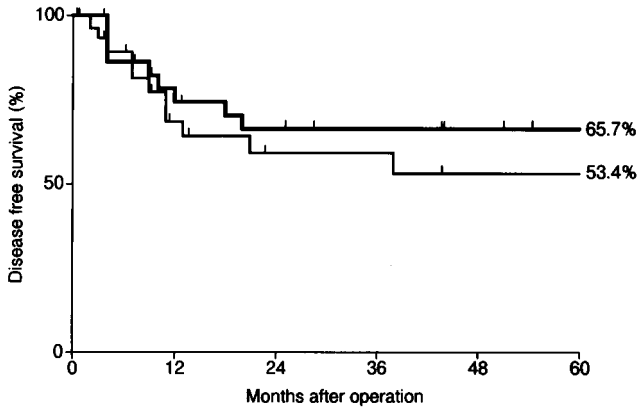

Fig. 1. Postoperative disease-free survival of patients who underwent SL (▬) and PN (—). No statistical significance was observed between them in the log-rank test ($P = 0.487$).

TABLE III. Incidence and Site of Recurrent Disease Among Nodal Status

		Local	Distant
SL	(N = 29)	3 (10.3%)	6 (20.6%)
	N0 (11)	1 (9.1%)	1 (9.1%)
	N1 (15)	1 (6.7%)	4 (26.7%)
	N2 (3)	1 (33%)	1 (33%)
PN	(N = 29)	6 (20.6%)	7 (24.1%)
	N0 (12)	1 (8.3%)	1 (8.3%)
	N1 (11)	2 (18.2%)	5 (45.5%)
	N2 (6)	3 (50%)	1 (16.7%)

(not significant) (Table III). The incidence and form of recurrence based on the status of each nodal metastasis are also shown in Table III. In the SL group, local disease was observed in one case each of 11 N0 (9.1%), of 15 N1 (6.7%) and of 3 N2 (33%), whereas distant recurrence in one N0 (9.1%), 4 N1 (26.7%), and 1 N2 (33%). In the PN group, local recurrence (defined as recurrence at the suture line of the bronchus, or hilar, or mediastinal lymph nodes) was observed in one of the 12 N0 (8.3%), in 2 of the 11 N1 (18.2%), and in 3 of the 6 N2 (50%), whereas distant recurrence was seen in one N0 case (9.1%), 5 N1 cases (45.5%)and one N2 case (16.7%).

DISCUSSION

The observed incidence of postoperative complications in lobectomy with bronchoplasty was found to be comparable to other studies [9,10]. We did not experience any bronchopleural fistula in our 29 cases of curable sleeve resection, whereas the incidence rate was reported to be up to 11% in previous reports [9,10]. However, 3 of 29 cases in the PN group were complicated by stump failure, and the incidence rate was similar to that of previous reports [11]. Either the low blood perfusion of the blind end of the resection margin or increased air way pressure may have influenced the higher rate of bronchopleural fistula after a pneumonectomy. The rate of cardiogeneic complications was also marked in the PN group. Operation-related death occurred in the two cases of PN group. There were five cases of operation-related deaths of a total of 129 pneumonectomies performed during the same period, and this number was also comparable to the previous report [12]. These results thus indicate that bronchoplasty is a safer procedure than a pneumonectomy.

One possible problem of sleeve lobectomy for malignant disease is the potentially increased rate of local recurrence due to the remaining lung tissue. Since the recurrence rate after sleeve resection has been reported to be as high as 51%, this procedure has up to now been considered to be only a limited operation and has mainly been indicated for patients with a compromised pulmo-

nary reserve until recently [9,10,13,14]. In particular, in the presence of nodal metastases, a sleeve lobectomy has been reported to result in poor local control [15,16]. More recently, several groups reported acceptable long-term results for a sleeve resection of lung cancer with N1 disease but not with N2 [17,18]. Pneumonectomy is therefore most likely a more appropriate surgical procedure for tumors involving the proximity to the hilum for curable intent. In this study, however, the SL group shows a somewhat higher disease-free survival rate than the PN group. The local recurrence was observed in three cases in the SL group and in six in the PN group. Regarding N1 disease alone, there was a similar rate of local recurrence between them (1 of 15 in SL, 2 of 11 in PN). These findings indicate a satisfactory local control of central lung cancer by a sleeve resection, which saves the portion of the lobes not involved with the tumor.

The results of this study clearly show sleeve resection to be a satisfactory surgical treatment for lung cancer in terms of both operative risk and curability, as well as regarding pulmonary function after operation. In comparison to pneumonectomy, the number of postoperative complications was also less frequent and there was no significant difference in disease-free survival. The PN group presented in this study was selected retrospectively according to the above mentioned criteria, and we thus speculated that all 29 patients also could have undergone a sleeve resection. The problem of this study is whether or not those two groups (SL and PN) clearly demonstrated the same disease condition or not, although there was no difference in the clinical profiles, in which the TNM status was completely in accord (Table I). However, among all pneumonectomy cases, it is clear that sleeve resection was more feasible in the PN group patients in this study than in the patients who were excluded based on the above criteria. A prospective randomized trial would hopefully resolve the above issue.

The indications of a sleeve resection for lung cancer, which is technically more demanding than a pneumonectomy, have yet to be elucidated. Therefore, the decision to select this procedure also may be influenced by the surgeon's skill or obscure factors. From the present results, however, we propose that a sleeve lobectomy should be performed for the centrally located lung cancer whenever feasible, because this pulmonary reserve-saving operation is safer and just as curable as a pneumonectomy in lung cancer.

ACKNOWLEDGMENTS

We thank Dr. B. T. Quinn, Kyushu University, for his critical review, and Ms. Yumiko Oshima for her expert help in the preparation of this manuscript.

REFERENCES

1. Price-Thomas C: Conserving resection of the bronchial tree. J R Coll Surg Edinb 1956;1–2:169–186.
2. Price-Thomas C: Lobectomy with sleeve resection. Thorax 1960; 15:9–11.
3. Jensik RJ, Faber LP, Milloy FJ, Amato JJ: Sleeve lobectomy for carcinoma: a ten-year experience. J Thorac Cardiovasc Surg 1972; 64:400–412.
4. Faber LP, Jensik RJ, Kittle CF: Results of sleeve lobectomy for bronchogeneic carcinoma in 101 patients. Ann Thorac Surg 1984; 37:279–285.
5. Watanabe Y, Shimizu J, Oda M, Hayashi Y, et al: Results in 104 patients undergoing bronchoplastic procedures for bronchial lesions. Ann Thorac Surg 1990;50:607–614.
6. Paulson DL, Shaw RR: Bronchial anastomosis and bronchoplastic procedures in the interest of preservation of lung tissue. J Thorac Cardiovasc Surg 1955;29:283–259.
7. Johnston JB, Jones PH: The treatment of bronchial carcinoma by lobectomy and sleeve resection of main bronchus. Thorax 1959; 14:48–54.
8. Mountain CF: A new international staging system for lung cancer. Chest 1986;89 Suppl:225S–223S.
9. Weisel RD, Cooper JD, Delarue NC, Theman TE, et al: Sleeve lobectomy for carcinoma of the lung. J Thorac Cardiovasc Surg 1979;78:839–844.
10. Tedder M, Anstadt MP, Tedder SD, Lowe JE: Current morbidity, mortality, and survival after bronchoplastic procedures for malignancy. Ann Thorac Surg 1992;54:387–391.
11. Hankins JR, Miller JE, Attar S, Satterfield JR, et al: Bronchopleural fistula: thirteen-year experience with 77 cases. J Thorac Cardiovasc Surg 1978;76:755–762.
12. Ginsberg RJ, Hill LD, Eagan RT, Thomas P, et al: Modern thirty-day operative mortality for surgical resections in lung cancer. J Thorac Cardiovasc Surg 1983;86:654–658.
13. Bennet FW, Smith AR: A twenty-year analysis of the results of sleeve resection for primary bronchogenic carcinoma. J Thorac Cardiovasc Surg 1978;76:840–845.
14. Vogt-Moykopf I, Fritz TH, Meyer G, Bülzerbruck H, et al: Bronchoplastic and angioplastic operation in bronchial carcinoma: long-term results of a retrospective analysis from 1973 to 1983. Int Surg 1986,71:211–220.
15. van Schil PE, de la Rivière AB, Knaepen PJ, van Swieten HA, et al: TNM staging and long-term follow-up after sleeve resection for bronchogenic tumors. Ann Thorac Surg 1991;52:1096–1101.
16. Firmin RK, Azariades M, Lennox SC, Lincoln JCR, et al: Sleeve lobectomy (lobectomy and bronchoplasty) for bronchial carcinoma. Ann Thorac Surg 1983;35:442–449.
17. Naruke T: Bronchoplastic and bronchovascular procedures of the tracheobronchial tree in the management of primary lung cancer. Chest 1989;96 Suppl:53S–56S.
18. Mehran RJ, Deslauriers J, Piraux M, Beaulieu M, et al: Survival related to nodal status after sleeve resection for lung cancer. J Thorac Cardiovasc Surg 1994;107:576–583.